SUMMARY OF RESEARCH

The main focus of this grant was analysis of the FIRE-3 Arctic Cloud Experiment (ACE) in 1998. This resulted in two peer-reviewed journal articles.

FINDINGS

Yum and Hudson (2001a) showed that the springtime Arctic aerosol is probably a result of long-range transport at high altitudes. Scavenging of particles by clouds reduces the low level concentrations by a factor of 3. This produces a vertical gradient in particle concentrations when low-level clouds are present. Concentrations are uniform with height when clouds are not present. Low-level CCN spectra are similar to those in other maritime areas as found by previous projects including FIRE 1 and ASTEX, which were also supported on earlier NASA-FIRE grants.

Wylie and Hudson (2002) carried this work much further by comparing the CCN spectra observed during ACE with back trajectories of air masses and satellite photographs. This showed that cloud scavenging reduces CCN concentrations at all altitudes over the springtime Arctic, with liquid clouds being more efficient scavengers than frozen clouds. The small size of the Arctic Ocean seems to make it more susceptible to continental and thus anthropogenic aerosol influences than any of the other larger oceans.

Other work involved further analysis of previously supported FIRE field programs— FIRE 1 and ASTEX. Yum and Hudson (2002) showed that there is significant inhibition of precipitation in the FIRE 1 and ASTEX stratus clouds. For thin stratus there was an order of magnitude more drizzle in polluted clouds compared with maritime clouds. There was a 15 μ m mean diameter threshold for drizzle that was often exceeded in maritime clouds but never exceeded in continental clouds. In ASTEX we observed an undercounting of small cloud droplets in polluted clouds that indicates a better level of closure between CCN and cloud droplets than previously indicated.

Ghan et al. (2001) compared CCN spectra measured in FIRE 1, ASTEX, FIRE 3 and five other projects with model predictions of CCN spectra. These showed good comparisons for supersaturations above 0.1%.

Yum and Hudson (2001b) used data from FIRE 1, ASTEX and four other projects to show that the mixing of dry air into clouds is generally homogeneous. This demonstrated that there is no enhancement of cloud droplet sizes due to mixing of air into the clouds that had been suggested to be a means of broadening cloud droplet spectra and thus promoting precipitation.

Publications supported by this grant

Peer-reviewed journal articles:

Wylie, D., and J.G. Hudson, 2002: Effects of Long Range Transport and Clouds on Cloud Condensation Nuclei in the Springtime Arctic. *J. Geophys. Res.*, in press Yum, S.S., and J.G. Hudson, 2002: Maritime/continental microphysical contrasts in stratus. *Tellus.* 54B, 61-73.

Ghan, S.J., R.C. Easter, J. Hudson, and F.-M. Breon, 2001: Evaluation of aerosol indirect

radiative forcing in MIRAGE, J. Geophys. Res., 106, 5317-5334.

Yum, S.S., and J.G. Hudson, 2001: Vertical distributions of cloud condensation nuclei spectra over the springtime Arctic Ocean. J. Geophys. Res. 106, 15045-15052.

Yum, S.S., and J.G. Hudson, 2001: Microphysical relationships in warm clouds. Atmospheric Research, 57, 81-104.

Conference Proceedings and oral presentations at these conferences:

Hudson, J.G. and S.S. Yum, 2000: Continental/maritime drizzle contrasts in stratus and cumuli. Proceedings 13th International Conference on Clouds and Precipitation, Reno, Nevada, USA, 14-18 August, 71-74.

Yum, S.S., and J.G. Hudson, 2000: Cloud microphysical relationships in warm clouds.

Proceedings 13th International Conference on Clouds and Precipitation, Reno, Nevada, USA, 14-18 August, 75-78.

Hudson, J.G., S.S. Yum, and Y. Xie, 2000: Cloud condensation nuclei spectral climatology.

Nucleation and Atmospheric Aerosols 2000, 15 International Conference, Rolla Missouri, USA, 6-11, August 252, 256. USA, 6-11, August, 853-856.

Additional conference presentations:

Hudson, J.G., 2001: Cloud Condensation Nuclei Climatology, Symposium on Global Aerosol Climatology Database, Oct. 13-14, Portland, Oregon, oral.

American Association for Aerosol Research (AAAR) Meeting; Portland, Oregon, October, 2001, poster